REMARKS

Favorable reconsideration of this application is requested in view of the foregoing amendments and the following remarks. Claims 1, 4, 6-12, 14-19, 33-46, 49, 51-59, 61-66 and 68-74 are pending in the application. Claims 2-3, 5, 13, 20-32, 47-48, 50, 60 and 67 were previously cancelled without prejudice or disclaimer.

The claims are amended in order to more clearly define the invention, support for which is found in the figures and related parts of the specification. Support for the amendment to claims 4, 35 and 52 is found at paragraphs 0047 and in figures 7-8. Claims 12, 14, 59, 61, 70 and 71 are amended as suggested by the Examiner.

Claims 12, 14, 59, 61, 70 and 71 were rejected under 35 USC 101. As noted above, claims 12, 14, 59, 61, 70 and 71 are amended as suggested by the Examiner.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 6, 8, 12, 14-19, 37-44, 46, 62-66, 73 and 74 were rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140). Schilling and/or Lee simply do not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Schilling (U. S. Patent No. 7,142,582) discloses a method to optimize the deployment of standard <u>slow</u> frequency hopping code-division multiple-access (FH-CDMA) to increase the overall data-transmission capacity in a microcellular system context by reducing the incidence of collisions of user signals. His intent is to enhance sharing of existing PCS-band spectra among legacy fixed microwave links (using high-power, tight-beam dishes) with new mobile, cellular wireless phone and data-services users, in accordance with transitioning FCC

regulations. This is accomplished by tightly synchronizing the respective base stations and remote units to facilitate efficient assignment of preselected time slots and frequency subbands for use in each subdivided (sectorized) cellular spatial region to avoid collisions (i.e., multiple-access interference) and simultaneously assigning different hopping channels to each subsector to overcome the usual loss of capacity in typical frequency-hopped CDMA cellular systems (his ¶4, lines 2-20). The coordinated FH among all users, coupled with the frequency sub-banding and spatial sectorizing of base-station antennas, is all controlled by logic in the respective base stations, which are in turn mutually synchronized (¶6, lines 49-61). At no point does Schilling suggest using fast hopping in his scheme, but instead recites several typical examples of ***slow*** hopping parameters as useful in his application (e.g., 8-32 kb/s data rates with a hopping rate of 2 khops/s) ; specifically, see his ¶11, lines 11-17. Further, (at ¶4, lines 21-31) Schilling actually teaches away from DS-CDMA systems or combined FH/DS systems due to their higher cost as opposed to his optimized, time slotted FH-CDMA scheme. ***At NO time does Schilling mention the use of FFH*** wherein multiple frequency hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies, ***much less any of the synergistic hybrid spread-spectrum techniques (i.e, DS/FFH, DS/FFH/TH, DS/FFH/POL, or DS/FFH/TH/POL) of the instant invention*** which requires that multiple frequency hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies..

Schilling (U. S. Patent No. 7,142,582), contrary to the Examiner's assertion (Office Action of 01/16/2007, ¶5) does ***not*** teach "generating a hybrid spread spectrum signal including modulating a carrier frequency of a direct sequence spread spectrum signal by frequency hopping." His mere mention of standard prior-art FH/DS systems in ¶4 (lines 27-31) is never

developed further. The system taught by Schilling is strictly FH/CDMA, where the CDMA component simply selects the hopping channel in use. In ¶4, lines 21-31, Schilling actually teaches away from DS techniques due to their higher claimed costs. Schilling further never mentions the existence of fast frequency hopping or hybrid spread-spectrum methods therefrom *per se* and thus at no point teaches the use of either with his system. In fact, the use of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies in particular (or HSS techniques in general) would be detrimental to the Schilling system, due to the much higher resulting cost and complexity of the customers' receiving hardware, as well as the greatly reduced bandwidth efficiency. Further, Schilling ***at no time*** discloses any hybrid spread-spectrum (HSS) transmission techniques combining DS and multiple frequency hops within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies at all, much less the specific DS/FFH technique and variants of the instant invention.

Lee (U. S. Patent No. 6,584,140) discloses a method of "fast" frequency hopping in which individual trellis-coded symbols are frequency-hopped at the symbol rate, with an encoded discrete phase appended to the hop frequency as a small offset. However, this does not meet the claimed limitation of wherein multiple frequency hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies because the symbols of Lee are composed of multiple bits.

The Lee technique, implemented as a modem for data channels, employs a new high-density signal design known as discrete trellis-coded modulation (d-TCM), in which standard frequency hopping is applied to each transmitted symbol of the QAM-modulated d-TCM stream. The encoding, in addition to the normal error-correcting functions, also applies a frequency

offset to each symbol corresponding to its phase. The possible number of phase increments can be 4, 16, 64, 256, or even higher, depending on the application. In the receiver, coherent amplitude and frequency demodulation provides high data rates, good spectral efficiency, and mitigation of repeat jamming by an adversary.

Very significantly, Lee at no time even hints at frequency-hopping rates exceeding once per bit. This is in stark contrast to the present invention, which specifically employs <u>at least</u> one hop per data ***bit*** (typically 3 or more) to achieve its intended result of error-free transmission in very harsh, multipath-prone RF environments. Even further, since each of Lee's d-TCM symbols represents ***multiple data bits*** (typically 6, as in his Fig. 2 and ¶6, lines 52-56), <u>then his effective hop rate is only $^1/_6$ of the bit rate, which is effectively ***slow*** hopping by the universally accepted definition</u> (multiple [e.g., 6] bits per hop)! Thus, according to standard-art definitions, his invention is mis-titled! Further, Lee makes no mention at all of any HSS signaling, much less the specific combination of FH with any other form of spread-spectrum (SS) modulation. His technique exhibits no actual instantaneous spread-spectrum process gain as do the techniques of the instant invention. Further, his methodology possess no particular advantage in a multipath environment; if delayed multipath signals are received within the nominal symbol period, the entire symbol can be easily corrupted. The use of d-TCM, although superior to conventional prior-art TCM (much as in standard 56-K dial-up telephone modems), improves the signal's bandwidth efficiency at the expense of decreased robustness versus multipath or other forms of RF interference (including jamming).

Further, the combined <u>single-symbol</u> FH/phase-encoding scheme of Lee will often fail in severe multipath environments due to the unpredictable phase response exhibited by the multipath-corrupted signal path, and thus fails to address a major demonstrated benefit of the

instant invention. Finally, Lee never alludes to <u>any</u> concatenation of his hopping technique with any other form of data modulation (much less spread-spectrum), as in the instant case. In summary, Lee <u>*at no time* discloses any specific hybrid spread-spectrum (HSS) transmission techniques [i.e., integrally combining DS and FH modulations] at all, much less the synergistic DS/FFH technique (or variants) of the instant invention.</u>

Lee (U. S. Patent No. 6,584,140) <u>contrary to the Examiner's argument</u> (Office Action, ¶5) does ***not*** disclose "a method of using a fast hopping system." Lee's title is highly misleading, as he only discloses one hop per multi-bit data symbol, which is illustrated (¶5, lines 13-25) as containing 6 bits. Thus, the system of Lee demonstrates <u>6 bits per hop</u>, which is by standard nomenclature ***slow hopping*** (less than 1 hop per bit). Further, Lee <u>***at no time***</u> <u>discloses or even hints at any hybrid spread-spectrum (HSS) transmission techniques [combining DS and multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies at all, much less the specific DS/FFH technique and variants of the instant invention.</u> Since Lee in fact discloses <u>slow frequency hopping</u> (one hop per 6 bits [i.e, one symbol]) rather than true fast frequency hopping (≥1 bit per hop), the arguments citing Lee as disclosing "fast" hopping are simply not valid. The use of "fast" in the title is merely a descriptor for the "frequency-hopped modem" system title; Lee does <u>not</u> perform multiple frequency hops within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies.

As noted above, Schilling ***at no time*** discloses any novel hybrid spread-spectrum (HSS) transmission techniques [i.e., combining DS and multiple frequency hops within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies] at all, much less the specific DS/FFH techniques of the instant invention that require that multiple frequency

hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies.. Since Lee does not disclose or suggest that multiple frequency hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies, Lee does not obviate this deficiency of Schilling. Therefore, even if one where to combine the techniques of Shilling and Lee, the resulting amalgamation would still not meet the claimed limitation of wherein multiple frequency hops occur within a single data-bit time and each bit is represented by chip transmissions at multiple frequencies.

Accordingly, withdrawal of this rejection is respectfully requested.

Claim 4 was rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140) further in view of Swanke (US 5,521,533). Schilling, Lee and/or Swanke simply do not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Swanke (U. S. Patent No. 5,521,533) only shows the use of a DDS in a basic frequency-hopping context, or two such devices in order to reduce the normal levels of spurious RF output signals to negligible amounts. Swanke never mentions any modulation form except basic FH.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 7, 9, 10, 33, 34, 36, 49, 51, 53-55, 59, 61, 68 and 70-72 were rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140) further in view of Alamouti et al (US 6,853,629). Schilling, Lee and/or Alamouti simply do not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time

where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Alamouti, et al., (U. S. Patent No. 6,853,629), hereinafter "Alamouti", discloses a combination method for cellular (PCS-band) communications involving essentially conventional frequency-division duplex (FDD), time-division duplex (TDD), time-division multiple-access (TDMA), orthogonal frequency-division multiplexing (OFDM), spatial diversity, and polarization diversity. The system is based on a complex control scheme to simultaneously handle the FDD, TDD, and spatial and polarization diversity schemes using a multiplicity of sectorized, polarized antennas with beamforming electronics. The result has excellent fade resistance and good bandwidth efficiency, and permits changing a given user's bandwidth on demand by assigning additional TDMA slots during the user's session.

Alamouti recites well-known textbook combinations of hybrid CDMA (spread-spectrum) protocols, including DS/FH, DS/TH, FH/TH, and DS/FH/TH but does not use specific implementations of these in his system or describe these in detail. However, Alamouti never even mentions multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies.

Alamouti also describes the use of polarization diversity, but conventionally assumes that in the use of polarization diversity the channel is essentially multipath-free, i.e., that the two orthogonal polarizations are not intermixed by multipath or oblique reflections in the intervening paths between the transmit and receive antennas. This benign-path assumption, however, where the two orthogonally polarized signals are statistically independent (i.e., fully separable) is, however, ***not*** valid for the high-multipath environments addressed by the instant invention;

for such, the methods of Alamouti to exploit the polarization diversity effect to obtain two clean channels will inevitably fail.

In contrast, claims 9-10, 33, 56-57 and 68 ***require*** the use of two time-synchronous (co-phased) orthogonally polarized waves (typically H and V), each transmitting the same data, to achieve the stated benefits of avoiding cancellation of the signal in highly reflective (multipath) environments (see instant ¶0042, ¶0072, and ¶0073). In general, due to the differing reflection coefficients in a high-multipath scenario for the independent H and V waves, at any given point in space if the H wave has a null, statistically the V wave will not. To exploit this fact, the instant invention requires that the H and V waves be in exact time sync when launched. The methods recited in Alamouti will work properly only in benign, line-of-sight RF paths but will in general fail in non-minimum-phase or highly nonlinear-phase paths (e.g., in heavy multipath situations) since the multipath will often scramble the polarization relationships in the signals of Alamouti and the receiver will be unable to correctly resolve the incoming signal components and, consequently, the two data streams. Thus, Alamouti's polarization-diversity technique will usually fail in high-multipath and high-noise environments, as opposed to the instant invention, which is expressly designed to provide good signal integrity (i.e., low bit-error rates) in such environments.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 11 and 45 were rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140) further in view of Becker (US 6,726,099). Schilling, Lee and/or Becker simply do not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Becker, et al., U.S. Patent 6,726,099 (hereinafter, Becker) discloses a bidirectional spread-spectrum RFID system using simple frequency hopping on the tag-to-reader RF link and standard direct-sequence spreading on the reader-to-tag transmissions (paragraph 4, lines 45-58; paragraph 6, lines 62-67 through paragraph 7, lines 1-7). The DS and FH modulations of Becker are never used on the same link, and no specific relationship between these component modulations is ever established. Becker never discloses true time-hopping modulation in conjunction with multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies, but instead pre-selects frequency channels and time slots for transmissions to minimize mutual interference among tags in his system, although he does disclose an optional pseudorandom selection of his tag transmission time slots. Thus, Becker never discloses the <u>concatenated hybrid spread-spectrum</u> methods of the instant invention, only <u>existing-art</u> spread-spectrum transmission techniques.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 35 and 52 were rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140) further in view of Alamouti et al (US 6,853,629) and yet further in view of Swanke (US 5,521,533). Schilling, Lee, Alamouti and/or Swanke simply do not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 58 and 69 were rejected under 35 USC 103 as obvious over Schilling (US 7,142,582) in view of Lee (US 6,584,140) further in view of Alamouti et al (US 6,853,629) and yet further in view of Becker (US 6,726,099). Schilling, Lee, Alamouti and/or Becker simply do

not disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies despite the occurrence of the term "fast" in the title of the Lee reference.

Accordingly, withdrawal of this rejection is respectfully requested.

In conclusion, none of the references applied by the Examiner disclose or suggest the claimed limitation of multiple frequency hops occurring within a single data-bit time where each bit is represented by chip transmissions at multiple frequencies or the specific claimed combinations of this feature with direct-sequence, direct-sequence/time-hopping, direct-sequence/time-hopping/polarization-hopping, or direct-sequence/polarization-hopping, nor their specific implementations or advantages in solving the explicitly described problem of communicating in a severe multipath-plagued signal-propagation environment.

Other than as explicitly set forth above, this reply does not include acquiescence to statements in the Office Action. In view of the above, all the claims are considered patentable and allowance of all the claims is respectfully requested. The Examiner is invited to telephone the undersigned (at direct line 928-226-1073) for prompt action in the event any issues remain that prevent the allowance of any pending claims.

In accordance with 37 CFR 1.136(a) pertaining to patent application processing fees, Applicant requests an extension of time from April 16, 2007 to June 16, 2007 in which to respond to the Office Action dated January 16, 2007. A notification of extension of time is filed herewith.

The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-3204 of John Bruckner PC.

Respectfully submitted,

John Bruckner PC
Attorney(s) for Applicant(s)

John J. Bruckner
Reg. No. 35,816

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PO Box 490
Flagstaff, AZ 86002-0490
Tel. (928) 226-1073
Fax. (928) 266-0474